Aquatic Resources Goals:

- Stem and reverse the decline in the health and abundance of estuarine biota (indigenous and desirable non-indigenous), restoring healthy natural reproduction.

- Restore healthy estuarine habitat to the Bay-Delta, taking into consideration all beneficial uses of Bay-Delta resources.

- Ensure the survival and recovery of listed (and candidate) threatened and endangered species, as well as other species in decline.

- Manage the fish and wildlife resources of the Estuary to achieve the goals stated above.

Problem Statement

For more than a century, humans have modified the habitats of the Bay-Delta Estuary and its watershed, and extracted its resources. Federal and state water projects were constructed in and upstream of the Delta for the primary purposes of water conveyance and distribution, but their effects on ecological systems were not adequately understood, addressed, or mitigated for. The result has been diminished ecosystem functions and the imperilment of estuarine habitats and biodiversity.

The pumping plants for the Central Valley Project (CVP) and the State Water Project (SWP) are located in the southern part of the Delta near Byron. These pumps divert water from the Sacramento-San Joaquin river system for conveyance south to farms and urban centers. During periods of high pumping relative to low outflow, water in the Delta channels and the San Joaquin River can flow upstream, resulting in the disorientation and mortality of anadromous and estuarine-dependent fish. Society, in spite of much investment and effort to date, has been unable to protect aquatic life from the direct and indirect effects of these operations.

Additionally, in the Delta alone, there are approximately 1,800 agricultural diversions that divert flows, ranging from several cubic feet per second (cfs) to several hundred cfs; only a few of these are screened. Industrial facilities in the Delta use estuarine waters in their cooling systems, where aquatic organisms are entrained in intake valves or impinged on fish screens.

Other possible causes for the decline of aquatic resources include habitat alteration by flood control and navigation projects, the loss of shaded riverine aquatic and riparian habitat (California has lost close to ninety-five percent of its riparian habitat since European settlement), the spread of non-native invasive species that out-compete native species of plants and animals, water pollution, and poaching. Recent stings by fish and wildlife agencies have uncovered and halted several ambitious poaching operations of striped bass and sturgeon.

Populations of four important species of estuarine fish—the endemic and threatened Delta smelt; the introduced striped bass, a popular sport fish; the native longfin smelt;

and the introduced threadfin shad—have declined since 1967, and all four species of fish showed a precipitous drop in abundance beginning in 2002. Resource managers have termed the phenomenon "pelagic organism decline," or POD. An interagency workgroup has formed to study the problem. The workgroup is examining data on food availability, disease, contaminants, toxic algae, predation, salinity, freshwater flows,[1] and entrainment. At this time, a great deal of uncertainty remains as to the causes and remedies for the decline.

Pollutants are another suspect in the decline of aquatic resources. Even at very low concentrations, they can cause sub-lethal effects on fish behavior, increase their susceptibility to disease and predators, and affect reproduction. Pyrethroids—synthetic insecticides modeled on pyrethrins that occur naturally in plants—were thought to be safer alternatives to organophosphate pesticides like diazinon, which is known to harm fish and is no longer on the market. But pyrethroids, too, have emerged as contaminants of concern. In the Central Valley alone, pyrethroid use tripled in the last decade, with 178,000 pounds used in 2003. Beginning in 2001, urban use exceeded agricultural use. Greater efforts need to be made to keep pollutants out of surface waters.

Existing Management Structure

The management structure for the Estuary as it relates to aquatic resources remains largely the same since the CCMP was first approved in 1993. However, there is one new and important player: A cooperative state/federal effort known as the CALFED Bay-Delta Program began in 1995, charged with balancing water supply reliability, water quality, ecosystem restoration, and sustainable levees. CALFED is currently focusing many of its efforts on problems related to the Delta (see "Challenges" section below). Also new since 1993, the state recently began the Delta Vision to plan for a future for the Delta that reflects current understanding of problems and opportunities. Nationally, and in this Estuary, the issue of levee stability is acknowledged as critical for both short-term and long-term ramifications. This will be a key focus for the management decisions that emerge from the Delta Vision.

Recommended Approach

The Recommended Approach to restore the Estuary suggested in 1993 remains valid, although it will be more complex, difficult, and costly to implement than envisioned fourteen years ago. While many new state bonds that include funding for environmental restoration have been passed since 1993, no new, more sustainable, large-scale funding sources have been identified and implemented. This is a serious issue and needs to be addressed as one of the highest priorities.

[1] The total annual volume of freshwater reaching the Estuary is highly variable, primarily as a result of California's variable precipitation patterns. Between 1921 and 1990, the annual flow of freshwater into the Delta ranged from about six million acre-feet (MAF) to more than fifty MAF, with an average of about twenty-four MAF. However, normal or above normal rainfall in recent years has meant improved inflows. In water-year 2004, inflows to the Delta and Estuary were 21.6 MAF, and 21.8 MAF in water-year 2005. Delta outflows were fifteen MAF in 2004 and fifteen MAF in 2005.

Today, government agencies, including CALFED; academic institutions; environmental nonprofits; and coalitions of many of these entities are working to improve the scientific basis for managing the Estuary and to restore the Estuary. One such coalition is the San Francisco Bay Joint Venture, a group of non-governmental organizations, utilities, landowners, and resource agencies collaborating to acquire, restore, and enhance wetlands on San Francisco Bay. Working together and with other agencies, members of this group have acquired, restored, and enhanced more than 60,000 acres around the Bay, including tidal marsh and flats, seasonal wetlands, creeks, lakes, lagoons, salt ponds, and open and subtidal water habitat.

The ongoing Regional Monitoring Program for Water Quality led by the San Francisco Estuary Institute has given us a better understanding of the impacts of a variety of contaminants on the Estuary's aquatic resources (see Pollution Prevention and Reduction Program).

Achievements, 1993–2007

Despite ongoing challenges and problems, there have been notable successes and progress in restoring some areas and functions of the Estuary and its watersheds since 1993. Anadromous fish habitat upstream of the Delta has improved in the fourteen years since the CCMP was approved. Restoration activities on Butte Creek, Battle Creek, and Clear Creek demonstrate that given access to viable habitat, salmon can increase in numbers. Significant improvement in controlling water temperatures has been achieved at a few large reservoirs, and this will benefit downstream salmonid populations. Some unscreened water diversions have been effectively screened for juvenile salmonids. Naturally spawning stocks of salmonids are being emphasized over hatchery stocks. Striped bass are no longer being stocked as juveniles, which were preying on the juveniles of listed species of salmon. The population of catchable-sized striped bass, a non-native species of high beneficial use, has returned to fair numbers, although continued low abundance of early life stages is still of concern.

Other activities that have taken place since 1993 that will benefit the Estuary's aquatic resources include the acquisition of thousands of acres of Bay habitats, including tidal marshes and flats, lagoons, beaches, salt ponds and open water/subtidal habitat, seasonal wetlands, and creeks and lakes. Current projects include the restoration of 49,000 acres and enhancement of 80,000 acres of those habitats. With the acquisition of the Cargill salt ponds in the South Bay, 17,700 acres of diked former baylands are in the planning process for and early stages of restoration.

In the North Bay, resource managers broke ground in 2005 to restore 3,000 acres of salt ponds to tidal marsh, and to enhance three additional ponds. At the former Hamilton Airfield in the city of Novato, 620 acres of filled baylands are being restored to tidal and seasonal wetlands. In the East Bay, many urban streams have been restored, improving water quality and supporting viable fish runs.

A Flow Management Standard for the lower American River was developed under the auspices of the Sacramento Region Water Forum in 2006 to correct water temperature

and minimum flow standard deficiencies. The Bureau of Reclamation, state and federal fishery agencies, and other stakeholders agreed to improved flow objectives, which will be recommended to the State Water Resources Control Board in 2007 for consideration and inclusion in the Bureau of Reclamation's water right permits for the American River.

Another significant achievement was the signing in 2006 of a groundbreaking agreement among agricultural interests, environmentalists, and others to restore flows to the lower San Joaquin River in an attempt to reintroduce and restore spring-run Chinook.

Challenges, 2007–2017

The breakdown of the Delta's aquatic resources base is a major challenge. Despite much research, scientists have not yet been successful in addressing the causes of the decline of the Estuary's open water (pelagic) resources. The Pelagic Organism Decline workgroup plans to take a closer look at top-down stressors like salvage and predation, and to release a report synthesizing its findings by late 2007. Many scientists believe that the decline probably has more than one cause, and/or that it is the result of the cumulative impacts of many problems—including non-native invasive species, water projects, pollution, and poaching. In addition to the focus on the Delta, a better understanding of Bay inflow needs and of whether tributaries (along with the Sacramento and San Joaquin rivers) have flows that will keep them in good condition for aquatic resources is required.

Yet the fate of the Estuary's aquatic resources may hinge, to a large extent, on the solutions derived for the Delta, the hub of the state's water supply system. Human water needs have been elevated in importance as the issues of population growth, climate change, levee strength, and risk to homes, property, and water supply have become more prominent, particularly after Hurricane Katrina struck New Orleans (also protected by levees), and after a levee broke in the Delta's Jones Tract in 2004, causing millions of dollars' worth of damage. State resource agencies are attempting to juggle and balance these needs in the Delta Vision directed by an executive order of Governor Arnold Schwarzenegger. Delta Vision is intended to be a "sustainable" solution that will balance the environment with water supply needs. The California Resources Agency, CALFED, and the Governor's office have established a Stakeholder Coordinating Committee and Blue Ribbon Task Force for the Delta Vision and Implementation Plan process. It is anticipated that a draft Delta Vision will be developed by December 2007 and a Strategic Plan recommended by December 2008.

Also needing focus and attention are the issues of both legacy and emerging contaminants, including an ever-growing trash and plastic debris problem (see Pollution Prevention and Reduction Program). Global warming, too, could pose unprecedented challenges for aquatic resources, as water temperatures rise, the timing and volume of flows change, and habitats are altered by floods, droughts, or new dams built to capture water earlier in the year as the snowpack continues to shrink. Tidal marsh restoration efforts could be slowed if there is a sediment deficit. Other potential worries are impacts to aquatic life from new desalination and power plants proposed for the Estuary. Perhaps the biggest unknown is how and in what form (via what new infrastructure) the state will

supply water—while still restoring flows and habitat for fish and wildlife—to its human population, predicted to increase by eleven million new residents by 2030.

Aquatic Resources Actions

Objective AR-1 (Revised 2007)

Improve the effectiveness of the techniques and programs used to monitor and evaluate ecosystem condition/"health" and the responses of the ecosystem to restoration projects, resource management and regulatory actions, and large-scale environmental change (e.g., global climate change and sea level rise).

ACTION AR-1.1 (Revised 2007)

Coordinate, and refine where appropriate, existing and future monitoring programs to improve our understanding of the current status and long-term trends of ecosystem condition in the Estuary. Make the information derived from monitoring programs available in published formats to serve a variety of audiences. The goal is to more fully characterize natural ecosystem processes and properties sufficient to allow us to enhance our understanding of how anthropogenic stressors influence ecosystem condition and to make informed management and regulatory decisions.

Who: Member agencies of the Interagency Ecological Program (IEP) for the San Francisco Bay-Delta Estuary, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, San Francisco Estuary Institute, PRBO Conservation Science, CALFED Bay-Delta Program, South Bay Salt Pond Restoration Project, and others conducting or sponsoring monitoring programs in the Bay-Delta system

What: Better coordinate, and refine where appropriate, Bay-Delta monitoring programs focused on physical, chemical, and biological conditions and changes along the axis of the Estuary between the Delta and extreme South Bay while at the same time maintaining those ongoing, long-term monitoring programs that continue to provide key understanding of the Estuary and its physical, chemical, and biological attributes and changes over decadal periods. Place increased monitoring emphasis on those specific locations where restoration or other management actions have the potential to change local/regional physical, chemical, and biological conditions. Emphasis in biological monitoring should be placed on detecting changes in populations of listed species, as well as in resident and migratory species populations considered critical to the well-being of the ecosystem in representative habitats in response to (a) physical, chemical, and biological changes brought about by both natural and anthropogenic stressors (e.g., processes related to climate change and sea level rise); (b) introduction of non-native invasive species; and (c) restoration or resource management actions, including Delta outflow management. Identify data gaps and discontinuities, and enhance predictive capabilities of ecosystem models. Finally, incorporate into all data collection programs a greatly increased emphasis on, and requirement for the synthesis, interpretation, and dissemination of, the monitoring results in published formats that serve a variety of audiences, including resource managers, decision-makers, scientists, and the public.